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10/524,118	03/17/2005	Matthieu Boehm	05007	2149

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EXAMINER	
SHEVIN, MARK L	
ART UNIT	PAPER NUMBER
1793	
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09/08/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/524,118	BOEHM ET AL.	
	Examiner	Art Unit	
	Mark L. Shevin	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 May 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *5-8* is/are pending in the application.

4a) Of the above claim(s) *7 and 8* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5-6* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Status of Claims

1. Claims 5-8, filed May 19th, 2008, are currently under examination. Claims 1-4 were cancelled, claims 5-8 are new, and claims 7 and 8 are withdrawn.

Status of Previous Rejections

2. The previous rejection of claims 1-2 under 35 U.S.C. 103(a) over **Fujihira** (US 5,518,823) in view of **Hong** (US 6,077,774) in the Office action dated March 14th, 2008 have been withdrawn in view of Applicants' cancellation of those claims.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 103

3. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Fujihira** (US 5,518,823) in view of **Hong** (US 6,077,774).

Fujihira discloses an aluminum foil (thin sheet) to be etched for use as the electrolytic condenser electrodes (cathode/anode of capacitor) that is composed aluminum of a purity of 99.9% or higher and an oxide layer 20-70 angstroms thick (3-7 nm) with at least one etching-nuclei forming element concentrated in the boundary region and/or in the outermost surface region of the oxide layer and having a thickness of 20 angstroms (2 nm) or less (Abstract). Fujihira teaches that concentration of free carbon (out of the group of P,V,Ti,Cr,Ni,Ta,Zr,C, Be on Col. 5, line 6) below a certain lower limit will bring about insufficient formation of etching pits while a higher concentration above an upper limit causes excessive etching (Col. 5, lines 5-15). The goal of adding elements such

as carbon is to, upon etching, maximize the effective surface area of the aluminum foil (Col. 1, lines 37-46). Fujihira does not teach the use of aluminum carbide:

Hong is drawn to providing a method for forming a relatively thin diffusion barrier on the surface of a metal conductor in a semiconductor device (Col. 1, lines 52-62). The thin diffusion barrier is form between a metal conductor and any surrounding layers, such as for example, a layer of dielectric material (Col. 2, lines 38-44). An important technical advantage of Hong's invention is the formation of diffusion barriers from metal oxides and metal carbides (Col. 1, line 65 to Col. 2, line 2). In one embodiment of the invention, a metal precursor gas is decomposed, via heating, on the surface of a metal conductor, thereby forming a thin layer on the metal conductor. The thin layer reacts with the subsequent dielectric layer to form a diffusion barrier. The first diffusion barrier, **15**, disposed between the metal conductor **14**, and a first dielectric layer **12** may be aluminum carbide (Col. 3, lines 14-22).

It would have been obvious to one of ordinary skill in the capacitor arts, at the time the invention was made, taking the disclosures of Fujihira and Hong as a whole, to combine Fujihira in view of Hong to form a thin aluminum sheet of 99.9% or higher purity with 5-25 at% of aluminum carbide in the 10 nm thick surface layer. This is because Fujihira taught the incorporation of carbon in the boundary region and/or in the outermost surface region of the oxide layer (2-7 nm thick, Col. 2, lines 19-21) and having a thickness of 20 angstroms (2 nm) or less (Abstract). Fujihira emphasized the importance of maximizing surface area through etching (Col. 1, lines 38-46) and that the concentration of the nuclei forming element, such as carbon, must be balanced between

not producing enough pits and producing too many pits which then fuse together (Col. 5, lines 5-15). Thus Fujihira teaches that by etching, the concentration of a given nuclei element such as carbon is a result effective variable in the maximization of surface area. Hong is similarly drawn to altering the interface between a metal conductor and a dielectric (oxide) film and takes the carbon suggestion further teaching the deposition of aluminum carbide at the metal - dielectric interface to act as a diffusion barrier. The resultant diffusion barrier after heat treatment is 10 nm or less in thickness (Col. 4, lines 7-9). One of ordinary skill in the art would know that aluminum carbide, as taught as forming a diffusion barrier by Hong, as a material that etches more slowly that aluminum. Motivation to combine the two references comes from the suggestion of Fujihira that a nuclei forming element such as carbon at the interface between the Al foil and the oxide layer improves capacitance and Hong teaches another way to treat the interface between a conductor (aluminum) and a dielectric interface (oxide layer).

Regarding claims 5 and 6, Fujihira had taught the use of a 99.9%+ purity Al-foil with a 2-7 nm oxide layer and carbon in a ~2 nm or less layer disposed between the Al foil and under the surface oxide. Thus the carbon content is within the 10 nm surface of claim 1. The content of carbon in the boundary inner layer **6**, between 1 and 40 ppm (Col. 8, lines 52-55) and Hong's invention teaches an essentially pure layer of aluminum carbide deposited. One of ordinary skill in the capacitor arts would be able to optimize within the range (low, 1-40 ppm by Fujihira and high, ~100% by Hong as a diffusion barrier) of aluminum carbide suggested by the two references as MPEP 2144.05, para I states: "A range can be disclosed in multiple prior art references instead of in a single

prior art reference depending on the specific facts of the case." Essentially what Fujihira and Hong teach is that aluminum carbide is advantageous for altering the etching process to maximize surface area and thus increase the effective capacitance.

Furthermore, although Fujihira had only taught an intermediate aluminum carbide layer of ~2 nm thickness, one of ordinary skill would have been motivated to increase the thickness of this layer to the claimed 10 nm thickness as Fujihira taught that greater the concentration of carbide, the greater the etching effect produced. Thus a thickness layer will contain more carbide and geometrically allow more surface area upon etching (deeper pits, col. 1, lines 38-46).

Response to Applicant's Arguments:

4. Applicants' arguments filed May 19th, 2008 have been fully considered but they are not persuasive.

Applicants assert (p. 5, para 2) that the cited references do not render the claimed invention obvious as Fujihira discloses a maximum carbon concentration at the interface of only 1200 ppm and does not suggest that the interface is 10 nm thick.

In response, Fujihira taught that the concentration of a given nuclei element such as carbon is a result effective variable in the maximization of surface area in that that concentration must be balanced between not producing enough pits and producing too many pits which then fuse together (col. 5, lines 5-15). One of ordinary skill in the capacitor arts would be able to optimize within the range (low, 1-40 ppm by Fujihira and high, ~100% by Hong as a diffusion barrier) of aluminum carbide suggested by the two references as MPEP 2144.05, para I states: "A range can be disclosed in multiple prior

art references instead of in a single prior art reference depending on the specific facts of the case." Essentially what Fujihira and Hong teach is that aluminum carbide is advantageous for altering the etching process to maximize surface area and thus increase the effective capacitance.

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Applicants assert (p. 5, para 4) that one of ordinary skill would not look to Hong in order to improve the performance of the electrolytic aluminum capacitor foil as Hong's field of invention is quite different from that of both Fujihira and the claimed invention and that Hong does not teach a barrier layer between aluminum metal and aluminum oxide (p. 6, para 1).

In response, Hong is related in providing thin layers, such as aluminum carbide, on metals. Secondly, Fujihira had already taught the arrangement of layers yet Hong additionally teaches a diffusion barrier **15** (aluminum carbide) disposed between a metal conductor **14** (aluminum) and a first dielectric layer **12** (aluminum oxide) and one of ordinary skill would recognize aluminum as fulfilling the role of a conductor and aluminum oxide as a dielectric.

Applicants assert (p. 6, para 2 and 4) that Hong's aluminum carbide layer is contrary to that of Fujihira do to Fujihira's teaching regarding excessive etching and this mismatch rises to the level of teaching away.

In response, Fujihira had disclosed carbon nuclei as result effective variable effective in controlling etching and pit formation and thus the resultant surface area of a capacitor film while Hong taught that essentially pure aluminum carbide may be deposited by metal precursor gas deposition and serves as a diffusion barrier and prevents metal atoms of the conductor from moving into the dielectric layer. While Fujihira taught that low concentrations of carbon nuclei are desirable, teaching that excessive etching occurs upon a high concentration of carbon does not detract from the range of aluminum carbide concentration formed by the combination of the two references as again, Fujihira had taught the concentration as a result effective variable.

Conclusion

5. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

-- Claims 5-6 are finally rejected
-- No claims are allowed

The rejections above rely on the references for all the teachings expressed in the texts of the references and/or one of ordinary skill in the metallurgical art would have reasonably understood or implied from the texts of the references. To emphasize certain aspects of the prior art, only specific portions of the texts have been pointed out. Each reference as a whole should be reviewed in responding to the rejection, since other sections of the same reference and/or various combinations of the cited references may be relied on in future rejections in view of amendments.

All recited limitations in the instant claims have been met by the rejections as set forth above. Applicant is reminded that when amendment and/or revision is required, applicant should therefore specifically point out the support for any amendments made to the disclosure. See 37 C.F.R. § 1.121; 37 C.F.R. Part §41.37 (c)(1)(v); MPEP §714.02; and MPEP §2411.01(B).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark L. Shevin whose telephone number is (571) 270-3588 and fax number is (571) 270-4588. The examiner can normally be reached on Monday - Friday, 8:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy M. King can be reached on (571) 272-1244. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

/Mark L. Shevin/
Examiner, Art Unit 1793
/Roy King/
Supervisory Patent Examiner, Art Unit 1793

September 3rd, 2008
10/524,118